

Green Infrastructure

As we partner to protect Virginia's outdoors, we must put balance at the center of land use decisions. We must create an effective model that encourages redevelopment in cities and suburbs and discourages the wasteful and unnecessary consumption of land farther out from our population centers. And we must reward communities that adopt and use balanced growth policies with economic development assistance and other incentives.

—Gov. Tim Kaine



Photo by Virginia Tourism Corporation.

"Green Infrastructure is our nation's natural life support system – an interconnected network of waterways, wetlands, woodlands, wildlife habitats and other natural areas; greenways, parks and other conservation lands; working farms, ranches and forests; and wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality of life for America's communities and people (Benedict and McMahon, 2006)."

Green infrastructure planning integrates outdoor recreation, open space, cultural resources and conservation lands into ongoing planning and land use management decisions. The 2007 *Virginia Outdoors Plan* encourages the state, regions and localities to employ green infrastructure land planning because it supports cost effective, sound economic development in harmony with land conservation, cultural resource protection and outdoor recreation. Using green infrastructure land planning guides development to less sensitive lands, which reduces time needed for permits, lowers costs of development, protects water quality and creates sustainable communities. Opportunities for strategically linking linear corridors of land together in this planning process maximizes environmental, habitat and human benefits of development created to meet the needs of growing populations.

Findings

- The long-term economic benefits more than offset the cost of acquiring and conserving green infrastructure lands.
- Green infrastructure planning supports implementation of multimodal transportation options and speeds up the process of approval for transportation needs.
- More than 77 percent of homebuyers consider natural open space as a community necessity and rank walking and bicycling trails high among desired community features. Increased property values demonstrate the premium landowners give to these amenities.
- Farms, forests and fisheries contribute significantly to Virginia's economy, both directly through their associated industries, and indirectly by supporting tourism and contributing to quality of life.

- Approximately 45,000 acres of Virginia's rural lands are converted annually to development.
- The VOP public input meetings indicated a strong desire by the public for walkable, livable communities.
- Land use tools for conservation authorized by state legislation are applied with varying degrees of regularity at the local level.

Recommendations

General

- The *Code of Virginia* should be revised to include green infrastructure planning objectives and the use of a green infrastructure land planning model in local comprehensive planning.

Leadership

- Green infrastructure planning needs to be coordinated between state agencies. This integration should include efforts that work in concert with green infrastructure planning, such as watershed management planning, strategic natural resource conservation, and cultural and historic resource planning. The interagency workgroup should develop a communications plan outlining ways to highlight economic and environmental benefits of green infrastructure, and identify proactive steps that ensure stakeholder input, boost public awareness, and expand citizen engagement in green infrastructure, watershed management and strategic conservation.
- Regional and state agencies should continue to educate and train leaders, elected officials and staff of local, regional and state government and conservation organizations about green infrastructure planning. Such training should include guidance on local zoning initiatives that can lead to changes in community design and transportation systems. Emphasis must be placed on the values of open space and the need to preserve it, as well as options for funding green infrastructure initiatives.
- Local governments should take the lead in securing green infrastructure through adoption and implementation of appropriate planning tools and policies.

Data development

- The Virginia Departments of Conservation and Recreation, Environmental Quality, Game and Inland Fisheries, Forestry, Transportation, Agriculture and

Consumer Services, Historic Resources and others should continue to invest in the maintenance and enhancement of critical spatial data for outdoor recreation and conservation. Input from and partnerships with the Virginia Association of Counties (VACo) and Virginia Municipal League (VML) should be incorporated into data development to build upon the work of the Virginia Conservation Lands Needs Assessment Workgroup.

- The Commonwealth should support the development of a Virginia Geographic Data Library (VGDL). The Florida Geographic Data Library (FGDL) could serve as a model for the development of a central data repository in Virginia. A VGDL should facilitate integration of the numerous spatial databases available to support strategic conservation activities and other natural resource and planning applications.

Funding

- State agencies and local governments should explore the use of available federal and state funding resources, including grants, foundations and transportation related funds, to support green infrastructure planning initiatives and conservation priorities at the local, regional and state levels.
- The benefits and importance of green infrastructure should be used to help state agencies and their conservation partners secure continuous and reli-

able conservation funding from both new and existing sources.

Local government initiatives

- Regional and local governments should adopt and implement the green infrastructure planning to ensure sustainable development of their community and a high quality of life for future generations.

(Reference: *The Conservation Fund: Virginia Green Infrastructure Scoping Study* www.greeninfrastructure.net/?article=2079&back=true)

Overview of green infrastructure

For the purposes of the 2007 *VOP*, green infrastructure refers to land planning that balances the benefits of open space with development. Green infrastructure planning emphasizes the importance of connections between blocks of open space, between developed and undeveloped areas and between society and the landscape. The use of a green infrastructure planning model results in the protection of undeveloped land and waterways that provide essential benefits to society – clean air, clean water, food, fiber, open space for recreation and a sense of place. Green infrastructure is integral to long-term effective management of natural and cultural resources that support ecological health and quality of life for citizens of the Commonwealth.



Green infrastructure considers natural resources alongside community needs. Photo by Nancy Sorrells.

Green Infrastructure

Typically, communities carefully plan and fund “gray” infrastructure, the roads, sewers, utilities and buildings before development occurs. The same level of investment and approval is needed for green infrastructure. Green infrastructure land planning encourages conservation of natural resources and directs development to suitable areas. Green infrastructure planning identifies and ranks vital natural resources in concert with other community needs and alongside gray infrastructure prior to development. This planning methodology guides land development and growth in ways that accommodate increased populations, but also protects natural resources providing long-term economic viability and community sustainability.

Need for green infrastructure in Virginia

Green infrastructure planning should be adopted in Virginia to facilitate development and reduce the loss of open space, agricultural and forest lands. Virginia’s demographic trends that influence the need for green infrastructure are discussed in Chapter VIII. Green infrastructure networks are necessary to improve water quality and protect ground water recharge areas and drinking water supplies. These networks also provide opportunities for outdoor recreation and protection of cultural resources.

Further justification for adoption of green infrastructure planning is supported by research from The Conservation Fund, www.greeninfrastructure.net.

Transportation

Transportation decisions often drive land development. To facilitate change, green infrastructure and watershed management methodologies should be incorporated into local transportation planning. In Virginia, land use and zoning authority lies with the localities, while the state, with a few exceptions, has the responsibility for transportation decisions. There are few incentives for municipalities to cooperate with one another and the state on transportation and land use issues. Transportation problems can therefore result from the reluctance of localities to plan based on existing transportation infrastructure or to plan in the absence of a connection to transportation planning. Conversely, roads constructed before changes are made in local comprehensive planning may actually create a market for development and force changes in land use. The current tax structure and lack of adequate funding for roads make it very difficult for local governments to resist developers’ prof-

fers that ultimately lead to a transportation system that lags behind development.

Efforts are currently underway to improve the land use and transportation connection. In its 2006 and 2007 sessions, the General Assembly took steps that allow local governments, with the assistance of the state, to better understand the transportation impacts of development decisions. The connections between land use planning and transportation are important and are being treated with high priority.



Route 11 corridor. DCR photo by Lynn Crump.

What does green infrastructure look like?

Green infrastructure is a network of ecologically significant blocks of landscape, called cores or hubs, which are connected by linear bands of green space, called corridors. These landscape components vary in size, function and ownership. Cores may be comprised of public parks, natural areas, working forests, farms and rural historic districts, while corridors may be scenic rivers, stream buffers, hiking trails and even scenic byways. Each component contributes to the economy, the physical and mental health of citizens, and the long-term viability of natural resources and communities.

The large landscape cores are important for several reasons. First, ecosystems function best on a large scale. The various natural communities and the many species that comprise them are highly interdependent. Take away a few species and many more may be lost. Second, many species require large blocks of interior habitat in order to prosper. These interior species do not compete well with those that concentrate on the edges. Human development such as roads, housing, power lines and other utility connections create abundant edge habitat. Third, fragmentation of habitats creates opportunities for the introduction and spread

of invasive species. Fourth, many ecological functions, such as cleaning the air and water of pollution, requires large expanses of forest and wetland. Lastly, businesses that rely directly on the land – primarily agriculture, forestry and tourism – are affected by economies of scale. Small, scattered farms and woodlots usually cannot support viable agricultural and forestal economies, nor are they attractive to tourists.

Corridors connecting the cores are also vitally important as avenues of travel for animals, plants and in some cases humans. Corridors allow for natural repopulation of areas that may have experienced a decline in certain species, and minimizes inbreeding by permitting the flow of genes between populations. Some environmentally sensitive features, such as stream courses, can only be protected with corridors. Linear corridors often offer scenic and recreational benefits, particularly when they follow rivers or trails.

Figure IV-1. Conceptual Model of VCLNA Natural Landscape Assessment



Both public and private lands make up green infrastructure networks. Some of the land may be publicly accessible, while other land is not. It is important for the public to understand that even though land may not offer public access, it may still provide community benefits such as scenic vistas, clean air, clean water, food, fiber and wildlife habitat.

Principles of green infrastructure

Green infrastructure principles provide a strategic approach to land conservation that benefits people, wildlife and the environment. Green infrastructure planning is based on sound science and land use planning theory and practice to integrate land conservation, outdoor recreation and existing cultural resources with land development. Green infrastructure planning involves input from landowners and other

stakeholders. Planning most often includes opportunities for making human connections and linkages alongside and within corridors. This type of planning serves as a fundamental building block for sustainable use of land that is good for the environment, the economy and communities.

Green infrastructure is cost effective

Over the long term, using a green infrastructure planning model and investing in green infrastructure lands can be much more economically effective than following current growth patterns.

Protecting watersheds

Investing in green infrastructure lands can often be more cost effective than conventional public works projects and can protect previously-made infrastructure investments. In the Roanoke area, American Forests conducted an urban ecosystem analysis to include Roanoke County, Roanoke City, and portions of Bedford, Botetourt, Craig, Franklin and Montgomery counties to determine how the landscape has changed over time.

The study found that since 1973, the ecology of the Roanoke area had changed dramatically. Forests have declined and urban development has expanded. The average tree cover declined from 40 percent to 35 percent. This tree loss resulted in a 17 percent increase in runoff, an estimated 515 million cubic feet of water. Assuming a \$2 per cubic foot construction cost to build stormwater retention ponds and other engineered systems to manage this runoff would total \$419 million. The stormwater capacity of this urban forest cover in 1997 was worth about \$2.04 billion, down from the 1973 value of \$2.46 billion, based on avoided stormwater retention facility construction. The tree canopy that was lost would have removed 2.93 million pounds of pollutants and 10 microns of particulate matter from the atmosphere annually at a value of approximately \$8.2 million per year.

Based on this analysis, the Roanoke area is studying policy for land use planning and growth management that considers the dollar values associated with green infrastructure when making land use decisions. In addition, consideration is being given to increasing and conserving trees and green space in urban areas. Geographic information systems and computer modeling are being implemented to track trends and changes over time (American Forests, June 2002).

Outside the Commonwealth, localities in other states are using cost analysis to make land protection decisions. For example, in the 1990s, New York City avoided the need to spend between \$6 billion and \$8 billion on new water filtration and treatment plants by purchasing and protecting watershed land in the Catskill Mountains for about \$1.5 billion. Likewise, Arnold, Missouri has dramatically reduced the cost to taxpayers of disaster relief and flood damage repair by purchasing threatened properties and creating a greenway in the floodplain.

Planning for growth

Florida is studying a seven-county Orlando region to consider the possibility of an alternative green infrastructure based model for growth and development. Currently 850,000 acres are developed within Central Florida. If current trends continue, 1,163,000 acres of new land will be developed by 2050 at a cost of \$94.7 billion. The green infrastructure growth model projects that 420,000 new acres and 329,000 redevelopment acres will cost \$37.8 billion, which is \$56.9 billion less than the current trend figure. The savings in development cost by using the green infrastructure model would finance the high-speed rail, transit systems and land acquisition necessary to make the alternative green infrastructure model feasible.

The green infrastructure scenario is based on a balanced planning approach that conserves environmentally sensitive lands and develops higher density residential areas around light and high-speed rail. To build support for this new development trend model, outdoor recreational opportunities, especially trails, will be promoted for public access to citizens. (www.metrocenter.ucf.edu/projects_penndesign.php)

Economic development

A vibrant economy ensures the financial resources to maintain healthy ecological systems and environmental quality. Preserving land and natural resources is critical to a community's economic vitality. Natural open space and trails are prime attractions for potential homebuyers, increasing property values and thereby local tax revenues. Over 77 percent of potential homebuyers rated natural open space as "essential" or "very important," and walking and bicycling trails are among the list of attributes most desired by homebuyers. Open space, outdoor recreation, and a clean, visually attractive environment draw and retain businesses and improve quality of life. The direct effect of conservation land and green infrastructure on major industries in Virginia is important to long-term economic stability of the Commonwealth.



Salt marsh on College Creek. DCR photo by Irvine Wilson.

Green infrastructure in Virginia

Plans to develop a statewide green infrastructure system

www.dcr.virginia.gov/natural_heritage/vclna.shtml

DCR is currently developing the Virginia Conservation Lands Needs Assessment (VCLNA) to identify and prioritize natural resource conservation targets across the state to support green infrastructure planning in Virginia. Initiated as a tool for the Virginia Land Conservation Foundation, the VCLNA will have broad applications for land conservation planning and will be available to local and regional agencies and conservation organizations. The VCLNA uses geographic information systems (GIS) to map significant natural features. By choosing specific models and data sets, analysts will be able to use the VCLNA to highlight areas that are important for conservation.

This system will allow for analysis of location and data on:

- Large, unfragmented natural habitats.
- Concentrations of natural heritage resources.
- Key outdoor recreation areas.
- Prime agricultural lands.
- Significant cultural and historic resources.
- Important areas for sustainable forestry.
- Critical areas for drinking water protection and water quality improvement.
- Scenic resources.

In an effort to make the VCLNA a comprehensive green infrastructure land planning tool, additional datasets are being created for the various needs of public and private conservation partners. A workgroup that consists of representatives from the private sector and all levels of government are helping to inform and guide the process.

Data sets for use in the VCLNA include:

- Spatially explicit sites identified as priorities through existing plans, such as Partners in Flight priority sites.
- Local parks, and local, natural features, which are useful for green infrastructure identification.
- Wildlife diversity for State Comprehensive Wildlife Conservation Strategy planning.
- Recreational lands and identified recreation needs for the *Virginia Outdoors Plan*.

- Forest use and forest economic data for sustainable forestry decision making.
- Surface and ground water sources for drinking water protection.
- Biotic and abiotic factors that influence stream water quality.
- Historic and cultural resource locations for historic resource protection.
- Prime agricultural lands for agricultural reserves.
- Growth measures for vulnerability analyses.

Virginia Wildlife Action Plan

www.dgif.virginia.gov

To continue receiving funding through the State Wildlife Grants program, Congress asked each state to develop a Wildlife Action Plan, known technically as a Comprehensive Wildlife Conservation Strategy (see Appendix G). This annual appropriation began in 2001 as the Wildlife Conservation and Restoration Program and has continued since as the State Wildlife Grants program. As part of its charge to the states, Congress identified eight essential elements to be addressed in the development of the action plan:

1. Species of greatest conservation need.
2. Habitats that support species of greatest conservation need.
3. Problems that these resources face.
4. Actions needed to address these problems.
5. Strategies for monitoring the effectiveness of the action plan.
6. Coordination with key partners.
7. Public participation.
8. Processes for formal action plan review.

These plans examine the health of wildlife and prescribe actions necessary to conserve wildlife and vital habitat.

The goals of the Virginia Wildlife Action Plan are two-fold: First, to prevent wildlife from becoming endangered, and second, to keep common species common. The process for developing the plan was science-based and incorporated existing information and geographic information system analyses, as well as expert input and review.

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The action plan identifies actions needed to conserve wildlife and habitats in Virginia in each of the state's ecoregions. Actions contained in the plan also identify needs for improved coordination, enhanced education and outreach, land protection, enforcement, planning, and necessary laws, regulations and policies.

The plan focuses on the following wildlife conservation issues:

- Loss of wildlife habitat to development.
- Poor air and water quality due to pollution and sedimentation.
- Lack of funding for conservation programs.
- Lack of public conservation ethic.
- Conflicts between humans and wildlife.
- Invasive and non-native plants and animals.
- Need for better coordination between conservation partners.

Virginia's Wildlife Action Plan highlights wildlife conservation opportunities and makes information available that supports green infrastructure modeling and planning.

Virginia Department of Forestry (DOF)

The Department of Forestry funded the 2004 *Advancing Strategic Conservation in the Commonwealth of Virginia: Using Green Infrastructure Approach to*

Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space and Other Critical Resources. As an outgrowth of this study, DOF has taken the lead in training professionals, planners, outdoor recreational enthusiasts and conservation practitioners in how to begin to implement green infrastructure planning at the local and regional levels. The DOF, through the *State of the Forests report*, has also developed data related to open space lost to development in Virginia that is important to green infrastructure modeling.

DOF supports green infrastructure through the following:

- Forums or training sessions on green infrastructure.
- GIS information and critical lands data for green infrastructure modeling.
- Modest funding from the Urban Community Forestry Program for green infrastructure pilot projects.
- Appropriate marketing and media relations for green infrastructure.
- Support of land trusts, watershed organizations and other non-governmental agencies in the use of the green infrastructure land planning model to target important lands for protection.

Virginia's United Land Trusts

www.dcr.virginia.gov/land_conservation/tools02f.shtml

Virginia's United Land Trusts (VaULT) has written a plan identifying regional priorities for land conserva-



Farm in Augusta County. Photo by Nancy Sorrells.

tion in Virginia. The plan was developed in cooperation with DCR and DOF. Six public meetings were held across Virginia in 2002 to gather input from land conservation interests. Based on this input and information from other existing sources, VaULT wrote this plan to help organizations target their resources and efforts.

For more information about this project, see Appendix H.

Advancing strategic conservation in the Commonwealth of Virginia

www.greeninfrastructure.net/virginia

In the summer of 2002, The Conservation Fund (TCF) received funding from DOF's Urban and Community Forestry Assistance Program to investigate the institutional capacity, support and structure for a statewide green infrastructure network. The study looked at the current institutional situation within the state government, as well as the programs and resources available from other public and private entities working statewide and regionally in Virginia. The result of the project proposes that green infrastructure "can provide Virginia with a strategic framework for land protection and growth while promoting smart growth and smart development." Guidance received from public and private conservation professionals in Virginia indicated a need to create a broader framework to ensure buy-in at the state, regional and local levels.

Recommendations from the report, *Advancing Strategic Conservation in the Commonwealth of Virginia: Using a Green Infrastructure Approach to Conserving and Managing the Commonwealth's Natural Areas, Working Landscapes, Open Space, and Other Critical Resources*, have been incorporated into the 2007 VOP to address the Commonwealth's need for sound outdoor recreation and conservation planning based on local actions, and state and regional support for these local actions (Benedict and McMahon, 2004).

DCR promotes and supports watershed planning through the field offices of the Division of Soil and Water (www.dcr.virginia.gov/soil_&_water/wmp.shtml) and the Division of Chesapeake Bay Local Assistance (www.dcr.virginia.gov/chesapeake_bay_local_assistance).

Blue and green infrastructure efforts

www.deq.state.va.us/coastal/coastalgems.html

Virginia Coastal Zone Management Program's Coastal Geospatial and Educational Mapping System (Coastal GEMS) is designed to present spatial (i.e. maps) and nonspatial (i.e. textual information, fact sheets and links) information focused on the "best remaining"

green (land based) and blue (aquatic) resources within Virginia's jurisdictional coastal zone. The first version of this application was released in the fall of 2006. It will be continually updated and improved through advisory workgroups, training sessions and ongoing interactions with Virginia's stakeholders.

Regional and local strategic conservation and green infrastructure efforts

Several green infrastructure efforts are underway in Virginia at the local and regional levels. Plans for incorporating green infrastructure planning at a regional level have begun in the Hampton Roads, New River Valley, Thomas Jefferson, Crater and Richmond regions. The regional planning district commissions are a logical entity for coordination and managing this collaborative planning approach with localities.

Hampton Roads Conservation Corridor Study synopsis

The Hampton Roads Planning District Commission (HRDPC) has completed development of the Hampton Roads Conservation Corridor Study, a green infrastructure based approach to identifying a regional open space network. The project involved multiple opportunities for stakeholder involvement and included a public education element. A corridor network was identified utilizing GIS modeling to analyze data from a variety of sources, including the National Land Cover Dataset, the National Wetlands Inventory and the Virginia Land Conservation Needs Assessment.

One of the products is a summary map that identifies areas that are highly suitable for conservation. The suitability ranking is based primarily on water quality and habitat protection value. In addition, opportunities for connectivity between these areas are identified. By outlining a linked corridor system, opportunities to minimize habitat fragmentation and protect contiguous riparian buffers are highlighted. The Hampton Roads Conservation Corridor Study final project report, maps and associated GIS data are available on the HRPDC web site: www.hrpdc.org/newpep/HRCCS.shtml.

Local comprehensive plans

Section 15.1-446.1 of the *Code of Virginia* requires that every local government must "prepare and recommend a comprehensive plan for the development of the territory within its jurisdiction." This is done for

Table IV-1. Local Resources for Green Infrastructure Planning

Zoning Tools/ Policy Options	Administrative Tools	
Sliding Scale	Dedication	Proffers
Performance Standards	Deed Restrictions	Agricultural or Forestal Districts
Planned Unit Development	Impact Fees	Urban Growth Boundaries
Cluster Development	Development Incentives	Conservation Subdivision
Overlay Districts	Adequate Public Facilities	Purchase of Development Rights
Transfer of Development Rights		Land Banking

“the purpose of guiding and accomplishing a coordinated, adjusted and harmonious development of the territory which will, in accordance with present and probable future needs and resources, best promote the health, safety, morals, order, convenience, prosperity and general welfare of the inhabitants.”

The comprehensive plan serves as a planning tool rather than a regulatory device and generally includes two components: the policy plan and the land use plan. The policy plan outlines the community's goals and objectives for land use, transportation and housing, while the land use plan, usually a map, shows the location of planned land uses. This includes areas planned for environmental protection as well as future growth. Although not required by law, all communities should include an open space and recreation component within their comprehensive plans. They can also include conservation areas, agricultural areas and forestry areas, where appropriate.

As a significant element in a complete assessment of area resources, an open space and recreation plan evaluates local assets and needs. It also provides criteria and direction for protecting resources, acquiring open space, and focusing on the implementation of appropriate planning and land protection mechanisms. To be successful, each plan must be tailored to the unique characteristics of the community for which it is developed and should include input from members of the community that the plan will serve. The local comprehensive plan is intended to provide guidance to all public and private entities engaged in land use decision making, including governmental agencies, private nonprofit organizations, commercial developers and individual landowners.

Zoning tools

Zoning is the traditional method by which Virginia counties and municipalities direct development. If it is consistent with the goals and objectives of the locality's comprehensive plan, zoning can effectively mini-

mize impacts on significant or unique natural features. There are two types of zoning utilized by local government agencies, conventional zoning and conditional development. Conventional zoning allows for the development of a property “by right” and is subject to the conditions of the applicable zoning category. Conditional development is subject to government-imposed administrative requirements, or may reflect the developer's voluntary agreement to provide certain amenities to offset the impacts of development as a condition of rezoning to a more intensive land use.

Overall, local jurisdictions that create zoning districts with the intent to preserve open space are more apt to preserve large areas of land, and in turn, large ecosystems. Subject to the changing political climate in which it is developed and subsequently implemented, zoning is sometimes criticized as a temporary solution to long-term, emerging problems.

Zoning tools that can be used by local governments to preserve open space include:

Sliding scale zoning

In this case, a baseline number of development rights for a parcel is granted. The number of development rights subsequently permitted above the base number is inversely proportional to the size of the parcel developed. This approach is most effective when applied in rural counties before large tracts have been subdivided and development pressures mount.

Performance standards or zoning

This approach encourages innovative site plans that minimize negative impacts on natural features, including open space. In this case, standards and zoning are based on permitted impacts rather than uses. Factors considered in site plan review include design, local growth rate, existing and proposed infrastructure, and municipal services. Performance zoning targets single or multiple impacts and can supplement or replace traditional zoning regulations.

Planned unit developments (PUDs)

PUDs usually include mixed uses that are clustered so that individual lots are small and open space is preserved. This allows for flexible development practices while continuing to meet overall density and land use goals. Communities often require that PUDs set aside a portion of the developed area for recreation, open space uses or both. Frequently, such developments include deed restrictions that are transferred with the title whenever the property is sold. These restrictions are constraints on the property use recorded in the property's deed.

Cluster development

Cluster developments allow residences to be grouped on a portion of a site to preserve the remaining open space, agricultural land or a unique natural feature. The property owner is given the right to increase the density of development beyond applicable zoning regulations in one section of the site in return for leaving the remainder as open space. Clustered development also reduces infrastructure costs for roads and storm water management systems by as much as one-half the total cost of conventional development strategies, thereby creating major economic incentives to developers.

Reston's design reflects clustered development. The City of Charlottesville and its surrounding counties use this approach to preserve the area's rural character.

Overlay districts

By superimposing an additional district boundary or designation (for example, a floodplain district) over existing zoning, the overlay creates a supplementary set of regulations to protect specific features such as drinking-water reservoirs, vulnerable watersheds, viewsheds and other natural or unique features worthy of protection.

Governmental and administrative tools

Dedications

As a condition to obtaining approval to build, localities often work with land developers to determine how much of the land being developed will be dedicated to open space.

Development incentives

Types of incentives include bonus densities offered to landowners or developers who wish to set aside large portions of their land, usually more than half, as open space.

Impact fees

These fees are assessed to the developer to help fund

infrastructure and public amenity costs generated by new development. Impact fees may be applied to off-site and on-site improvements. Localities in Virginia have very limited authority for impact fees.

Adequate public facilities

In some states, the adequacy of services available to the type, timing and amount of land use demand are taken into consideration in zoning approvals. Concurrency policies require that public facilities be available to support development as it occurs. Although used in some other states, Virginia's legislature has not yet provided authorization to localities to consider adequate public facilities when granting development permits.

Policy option tools

Proffers

Used widely in Virginia, proffers mitigate development impact through the construction of public improvements or the donation of land or cash. Proffers have been used successfully to create vegetated buffers and open space for playgrounds within new developments on a localized scale, but are of limited use in preserving large areas as open space. The 2006 session of the General Assembly passed legislation that allows localities with population growth of 5 percent or more, and some adjacent localities, to include provisions pertaining to proffers in their zoning ordinances (*Code of Virginia* §§15.2-2298 through 15.2-2303.2).

Agricultural and forestal districts

These districts are created by agreement among landowners and the local government, and consist of a minimum of 200 acres that must be kept in agricultural, horticultural, forestal or open space use for four to 10 years, as specified by the agreement. Property owners may not subdivide their property for the term of the agreement. Landowners may withdraw from the program under certain defined circumstances. In exchange, the community agrees to minimize the impact of adjacent development on agriculture. The property is taxed at the use value tax rate whether or not a local ordinance for use value exists. For more information about land use value assessments and taxation, see Chapter II: Land Conservation.

Urban growth boundaries

Goals associated with the establishment of an urban growth boundary include containing urban sprawl and providing for an orderly transition from urban to open space uses. Strong regional planning and cooperation among localities is essential to success. The low cost of implementation and the ease with which this tool could be combined with a transfer of development rights program are primary advantages.

Conservation subdivision and limited development

This approach protects identified significant natural, historic, archaeological or unique features on a parcel by limiting development to a specified section to protect and preserve its significant features. This approach may be combined with the donation or sale of a conservation easement to assure resource protection.

Purchase of Development Rights (PDR)

In this case, the landowner is paid the difference between the value of the land based on its development potential and its value at its existing use. Once acquired, the property's development rights are extinguished by placing a conservation easement on the property that perpetually protects the conservation values associated with that land. Although government programs benefit from a dedicated source of stable revenue, funding sources for PDR programs vary between jurisdictions. Under Virginia law, service districts may be created to allow local governments to impose special assessments to generate funds, which may be used for the purchase of development rights determined to be of benefit to the community.

Table IV-2. Localities with Purchase of Development Rights (PDR) Program

Locality Name	PDR Program Status
Albemarle	developed - funding
Augusta	not developed - funding
Clarke	developed - funding
Culpeper	development in progress
Cumberland	development in progress
Fauquier	developed - funding
Franklin	development in progress
Frederick	developed - no funding
Gloucester	possible development
Halifax	possible development
Hanover	possible development
Isle of Wight	developed - funding
James City	developed - funding
Loudoun	developed - no funding
Nelson	developed - no funding
New Kent	developed - funding
Northampton	developed - funding
Rappahannock	developed - funding
Rockbridge	developed - funding
Shenandoah	possible development
Spotsylvania	developed - funding
Stafford	developed - funding
City of Chesapeake	developed - funding
City of Virginia Beach	developed - funding

(VDACS, May 2007)

Transfer of Development Rights (TDR)

The 2006 General Assembly authorized localities to establish a limited voluntary TDR program upon adoption of a local ordinance. TDRs, like PDRs, compensate landowners for reductions in their ability to develop the land and help preserve open land deemed important by the locality. Under a TDR program, development rights, or density units, are transferred from an area where preservation is desired (the "sending area") to an area that is more able to accommodate a higher density (the "receiving area"), usually an area with existing infrastructure. In this case, the developer, who stands to profit from the higher density in the development area, pays the landowner directly for the development rights. In a voluntary program, existing zoning in the sending area remains until a TDR sale or transaction occurs. Then the land is "downzoned," which means the density of permitted development is restricted.

Green infrastructure keys to success

Drawing on work underway in states, regions and communities across the country, steps to a successful green infrastructure initiative include:

- Create a leadership group to guide the green infrastructure initiative.
- Design a green infrastructure network to link green space components across scales and political boundaries.
- Develop an implementation plan to make the network design a reality.
- Prepare a management and stewardship plan that meets the restoration and maintenance needs of all green infrastructure network components.
- Inform and seek input from the public on green infrastructure network design and plan.
- Integrate green infrastructure into the planning processes of local, state and federal agencies and other community and regional planning efforts.
- Sell the public on the benefits of green infrastructure and the need for a green infrastructure network design.
- Build partnerships with the people and organizations that can help support and sustain the green infrastructure initiative.

(Source: Green Infrastructure by Mark A. Benedict and Edward T. McMahon. © 2006 The Conservation Fund. Reproduced by permission of Island Press, Washington, D.C., Table 4.1, p. 86.)

Community design trends

In many areas, the use of the automobile and the building of roads leading from traditionally urbanized centers to the suburbs have created a pattern of growth along linear corridors to accommodate low density, large lot development outside of the urban center. This pattern has resulted in fewer people living on more acres of land than in the past. These communities consume large acreages of land and fragment open space and natural areas, which stresses land and natural resources. These communities are not walkable and the automobile is essential for mobility. Green infrastructure planning creates an alternative development concept where environmentally sensitive land is purchased for preservation and regional transit systems are implemented. As development is proposed, the following community design methodologies may be incorporated into green infrastructure planning.

For the city is not a hostile and alien entity thrust upon the natural environment. The urban organism, like most others, depends for its well-being upon pure water, clean air, and productive soil. Problems of land use, water development, pollution, and wise use of natural resources are the concern of city and countryside alike.

—Robert C. Weaver, North American Wildlife and Natural Resources Conference, Houston, March 1968.

Community design planning methodologies for improved quality of life

Green infrastructure planning methodology may incorporate varied programs that address quality of life. A summary of methodologies that integrate outdoor recreation, cultural and natural resource conservation into planning include the following concepts.

Green infrastructure as defined by the Conservation Fund and the USDA Forest Service is the nation's life support system – a strategic and managed network of wilderness, parks, greenways, conservation lands and working lands with conservation value that supports native species, maintains ecological processes, sustains air and water resources, and contributes to the quality of life within communities. (www.greeninfrastructure.net)

Sustainable development recognizes the need to accommodate growth in a manner that preserves the character of the community, protects environmental resources and enhances economic vitality. It can be

practiced over time without depleting the existing or future natural resource base. Sustainable development is an ecological model that weighs economic development against the loss of open space, farmlands, forests and natural areas. Sustainable development may be achieved through green infrastructure planning. (www.epa.gov/sustainability and www.vsb.org).

Smart growth promotes revitalization, redevelopment and infill in urban and suburban areas and encourages development around established community centers already served by utilities and other public facilities. Smart growth links sustainable development with the availability of infrastructure, water and land based resources to support the community. (www.smartgrowth.org)

The Smart Growth Implementation Assistance Program is administered by the Development, Community, and Environment Division in U.S. EPA's Office of Policy, Economics, and Innovation. Through this program, a team of multidisciplinary experts provides free technical assistance to communities, regions or states that want to develop in ways that meet environmental and other local or regional goals. For more information and application materials, please go to www.epa.gov/smartgrowth/sgia.htm.

Active living, as promoted by Active Living by Design, promotes environments that offer choices for integrating physical activity into daily life. This philosophy recognizes the role transportation has, not only in how people move from place to place, but also in the character of the communities and choices and opportunities people are provided. (www.rwjf.org)

Livable communities are described as being attractive, walkable, have quality of public space, a variety of uses and building types, provide connection to people and their daily needs and places to walk for pleasure. (www.livable.com)

Leadership in Energy and Environmental Design (LEED) for Neighborhood Development was developed by the U.S. Green Building Council. The guidelines and rating system may be helpful in planning community design as a part of green infrastructure. (www.usgbc.org)

Context sensitive solutions (CSS) is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility. CSS is an approach that considers total

context within which a transportation improvement project will exist. (www.contextsensitivesolutions.org)

New urbanism is a development strategy that addresses growth issues to reduce traffic, create sustainable development and make smart transportation investments by creating communities that are livable, walkable and sustainable, which raises the quality of life. (www.newurbanism.org)

Placemaking is addressed by the Project for Public Spaces. The goal of placemaking is to create a place that has both a strong sense of community and a comfortable image, as well as a setting for activities and uses that collectively add up to something more than each individual feature of a design. (www.pps.org)

Awahnee principles, espoused by the Local Government Commission for economic development, emphasizes community and regional collaboration that embraces economic, social and environmental responsibility for building prosperous and livable places. (www.lgc.org)

Low Impact Development (LID) is a comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds. This design approach incorporates strategic planning and implements various land planning and design practices to simultaneously conserve and protect natural resource systems and reduce infrastructure costs. Goals of LID incorporate preserving open space and minimizing land disturbance, protecting sensitive natural features and natural processes and identifying and linking on-site and off-site green infrastructure. (www.lowimpactdevelopment.org and www.huduser.org/Publications/PDF/practLowImpctDevel.pdf)

Walkable Communities was established in the state of Florida in 1996. It was organized for the express purposes of helping whole communities, whether they are large cities, small towns, or parts of communities, become more walkable and pedestrian friendly. The Walkable Communities, Inc. reports that the key to urban ground transportation is the ability to walk in a

community. Urban communities that adequately accommodate pedestrians generally promote the sustainability of natural and economic resources, encourage more social interaction and physical fitness, as well as have fewer crime and other social problems. Walkable communities are pleasant and enjoyable communities that help people lead whole, happy and healthy lives. (www.walkable.org)

Traffic Calming involves techniques to minimize the impact of traffic by imposing elements of human scale and employing methods to slow traffic in pedestrian areas. Widened roadways constructed to facilitate increased traffic have severed more and more communities, making safe facilities for pedestrians limited. The American Society of Landscape Architects and the Federal Highway Administration, among others, are proponents of traffic calming measures that integrate pedestrians and bicyclists safely alongside vehicular traffic. (www.trafficcalming.org and www.fhwa.dot.gov/environment/tcalm)

Additional Resources for Green Infrastructure

The Conservation Fund (TCF) - This non-membership, non-advocacy organization is one of America's foremost conservation nonprofits that has led the way in promoting strategic land conservation through green infrastructure. www.conservationfund.org

Nonpoint Education for Municipal Officials (NEMO) – An educational program for local land use officials that addresses the relationship of land use to natural resource protection. www.nemo.uconn.edu

Active Living Leadership - A national partnership initiative supported by the Robert Wood Johnson Foundation to help state and local leaders create and promote places, policies and programs that enable active living and healthy eating. www.activelivingleadership.org

Community and Environmental Defense Services (CEDS) – Helps people defend their community and environment from the impact of sprawl and other flawed development projects. A nationwide network of attorneys, planners, environmental scientists, traffic engineers, political strategists, fundraisers and other professionals. www.ceds.org

References

American Forests. Urban Ecosystem Analysis Roanoke Area, Virginia, June 2002. www.americanforests.org/downloads/rea/AF_Roanoke2.pdf.

American Society of Landscape Architects. Partnerships and Resources, February 2007. www.asla.org/members/publicaffairs/partnerships.html.

Benedict, Mark, Will Allen, and Ed McMahon. 2004. *Advancing Strategic Conservation in the Commonwealth of Virginia: Using a green infrastructure approach to conserving and managing the Commonwealth's natural areas, working landscapes, open spaces, and other critical resources*. The Conservation Fund.

Benedict, Mark and Ed McMahon. 2006. *Green Infrastructure: Linking Landscapes and Communities*. Washington, DC: Island Press.

Center for Watershed Protection. Why Watersheds? PowerPoint Presentation. www.cwp.org/whywatersheds_files/frame.htm.

The Conservation Fund and USDA Forest Service. www.greeninfrastructure.net.

Frumkin, Howard. 2001. Beyond Toxicity. *American Journal of Preventive Medicine*.

Heimlich, R. E. and W. D. Anderson. 2001. *Development at the Urban Fringe and Beyond: Impacts on agriculture and rural land*. Washington D.C.: U.S. Department of Agriculture, Agricultural Economic Report 803.

Metropolitan Center for Regional Studies, The. Penn Design Central Florida Rollout Finding an Alternative Future. University of Central Florida. www.metrocenter.ucf.edu/projects_penndesign.php.

Porter, Douglas R. and Rutherford H. Platt. 2000. *The Practice of Sustainable Development*. Washington D.C.: Urban Land Institute.

VTrans 2025. the Commonwealth of Virginia's statewide long-range multi-modal transportation plan. www.vtrans.org.

Virginia's Population Projections: 1995 to 2025. U.S. Census Bureau. www.census.gov/population/projections/state/9525rank/vaprsrel.txt



Freshly fallen snow blankets trees in Albemarle County. Photo By DOF.